out of place to note that Prof. George Davidson has corrected a statement published in the description of the earthquake at San Francisco on February 18, 1856, where one writer states that "the water in the Bay of San Francisco rose, maintained its level for five minutes, and then sank 2 feet below its ordinary stage". Professor Davidson obtained a tracing of the mareograph from the Coast Survey, and this shows that the trace of the water level was remarkably smooth on the date in question.

Presentiments of the earthquake have been reported by reliable witnesses. Many people have stated that they past a restless night preceding the earthquake and were awake some hours before the earthquake occurred. Reports were also made of unusual manifestations made by animals. Our explanation of such conditions is that sleeplessness or unusual manifestations of the nervous system are not infrequent in California during the passage of a well-marked area of high pressure accompanied by low relative humidity and northerly winds.

Incidentally we may mention that the Weather Bureau records were faithfully and regularly made on April 18, the day of the earthquake. The great shock was at 5:13 a. m., and the Weather Bureau records are complete up to 5 p. m. of that day. The building caught fire on the evening of April 18. We lost three observations during the three days' fire, namely, a. m. of the 19th, p. m. of the 19th, and a. m. of the 20th. Our records begin again about noon of the 20th, while the fire was still raging.

THE CHRISTMAS SNOWSTORM OF 1906.

By HUGH ROBERT MILL, Director of the British Rainfall Organization, 62 Camden Square, London, NW.

[Reprinted from British Rainfall, 1906.]

By Christmas eve 3,521 circulars containing forms for recording the rainfall of 1907 had been prepared for posting, tied up in bundles of 60 each, and left ready at 62 Camden Square, to be sent to the post-office on the appointed day. The assistants had left for their short and well-earned holiday, and there seemed to be a week of comparative leisure before us. On the morning of Boxing Day (1906) the whole neighborhood of London was found covered with 4 or 5 inches of snow, which had come down in the night, and at Mill Hill the circumstances were so interesting that we resolved to make a special and detailed investigation into the storm, if so soft and silent an envelopment could be called by such a name. The night of the 25th had been fine and star-lit, with white clouds appearing about 10 p. m. in the southwest, and at 11 p. m. no snow or rain was falling. Next morning, at 7 o'clock, the sky was blue and clear, the wind blowing cold as a light breeze from the northeast, and grass and trees were covered alike with a snowy fleece. There had evidently been a fierce wind in the night, for the snow was drifted deeply against walls and hedges, and plastered thickly on the southwestern sides of trees and walls; the northeastern sides were entirely clear, showing that there had been a shift of the wind to a diametrically opposite quarter since the drifting ceased.

Next morning the newspaper reports showed that the snowfall had been very widespread, and we sent the accompanying form[1] to the printer, in order to give all rainfall observers an opportunity of recording their experiences. By the evening the first batch of copies was received. It took the evening of the 27th and nearly all day on the 28th to get the 3,000 ungummed envelopes loosened from their bundles, opened, the slips inserted, and the envelope flaps tucked in and made up again in bundles of 60. The 521 packets in closed envelopes for those observers who report monthly could not be dealt with in this way, so snow circulars for that number had to be separately addressed; but at length they were completed and dispatched just before the closing time of the post-office on the 28th.

The number of slips which returned to us with information was 1,862, and we must regretfully acknowledge that we have not been able to do more than touch upon some salient lines of the information they contained. All are preserved, and we hope they can be further utilized. The storm was not the isolated phenomenon which the first newspaper reports had led us to expect. It was followed for several days by snowy conditions, and it was soon apparent that during the last week of the year there were two separate snowstorms, one on the 25th and 26th, which affected the west of Scotland and the whole of England, except the northeast, gently and with little inconvenience; and another on the 27th and 28th, which was very severe indeed in the east of Scotland, in Ireland, and the southwest of England. In parts of Yorkshire and the border counties both storms appeared, and in some of these places it is difficult to distinguish between them. The second storm was accompanied by strong electrical disturbances and a severe gale, so that the light, powdery snow was driven into enormous drifts, causing much distress to farm and village dwellers in Aberdeenshire and adjacent counties. Aberdeen itself was cut off for several days from telegraphic and railway communication with the rest of the country. A terrible railway accident occurred in the thick of the storm at Elliott Junction, near Arbroath, causing loss of life, and the storm was in every way one of the severest on record.

After a cursory examination of the returns, and the elimination of those the statements on which were too vague to be useful, we decided to deal only with the first storm, and to limit our work to a consideration of the depth of snow over the country and the hour at which the snowfall commenced. This storm was by no means the severest, and perhaps not the most widespread, in recent years; but the great quantity of data obtained from skilled observers makes it possible to deal with it more exactly than has ever been practicable before.

We have made many maps of heavy falls of rain, but it is a very difficult thing to map a light fall, on account of the uncertainty as to the date of entry by observers who do not consistently follow the rule. In the case of a heavy fall, the individuality of the day is so well marked that those who enter to "wrong day" are immediately detected. A fall of snow is much more conspicuous than a shower of rain, and estimates of the depth of snow, though individually less accurate than measurements of the fall of rain, may collectively give a good general account of what is equivalent to a light shower; hence one part of the value of studying snowfall.

Care was taken first to eliminate those returns which lumped together the snowfall of several days, and all the figures which belonged to the period 25–26th were plotted on a map on the scale of about 20 miles to an inch. The error in measuring snow may lead to over or under estimates, for drifting increases the depth in some places and diminishes it in others; hence it is to be expected that large figures will sometimes be found amongst a group of small values, and that a few small figures will be found in the midst of an overwhelming crowd of larger. But when, as in this case, the figures are very numerous it is easy to see and to ignore the minority of dissentient values, be they too high or too low, and we found it possible by following the majority to prepare a very serviceable map of the depth of snow on the day in question. This map we reproduce on a reduced scale (fig. 1). It shows in solid black those parts of the country where no snow fell; but there was precipitation on that day in the form of rain over the western areas at least, where the temperature did not admit of the formation of snow. The area of the snowfall is seen to be a zone (150 miles broad in the north and widening to 200 miles in the south) stretching from northwest to southeast from the north of Ireland and west of Scotland to the English Channel

[1] Omitted in this reprint.—EDITOR.

and North Sea. The zone is parallel to the track of a secondary depression which crossed the British Isles on the 25th and 26th from the North Channel between Ireland and Scotland to the mouth of the Thames, the center being at the former point at 6 p. m. of the 25th, and at the latter at 8 a. m. of the 26th. The snowfall was heaviest on the left of the track, and although the distribution shows some irregularities which may be due in part to the uncertainty of the estimates of depth, it is plain that the heaviest fall occurred in a central belt (left white on the map) running from Manchester and Leeds to Lincoln and Ipswich. Here for a length of 200 miles and a mean breadth of 40 miles the depth of the snow everywhere exceeded 8 inches, while over nearly the whole of Norfolk and Suffolk the depth exceeded 10 inches, and in the center of these counties, over nearly 1,000 square miles, the snow lay to the depth of a foot. It appears to be possible that the snow of the storm which brought such heavy falls to the east coast on the 27–28th may have begun in Norfolk before the snow of the 25–26th stopped, and that this may account for the great depth recorded there. From the axis of maximum snowfall the depth fell off very quickly to the northeast, and extremely gradually to the southwest. It is interesting to note that the area of snowfall under 2 inches is greatest in the valleys of the lower Severn and Warwickshire Avon.

FIG. 1.—Map of British Isles, showing depth of snowfall of the Christmas snowstorm, 1906. Black areas indicate no snow (but possibly rain); shaded and white areas indicate snowfall, the darkest shading signifying the least depth.

In order to assist us in correcting the ordinary rainfall returns for snow which was improperly excluded, we prepared a rough map of the total depth of snow for the last week of the year. This map showed three distinct centers of maximum snowfall in the northeast of Scotland, in East Anglia and in the north of Ireland. It showed an absence of snow around the Bristol Channel, and a curiously isolated area in the center of the Lowland Plain of Scotland between the firths of Forth and Clyde, where there was extremely little. That area, in fact, escaped the two great storms, while all round it the country had been visited by one or both.

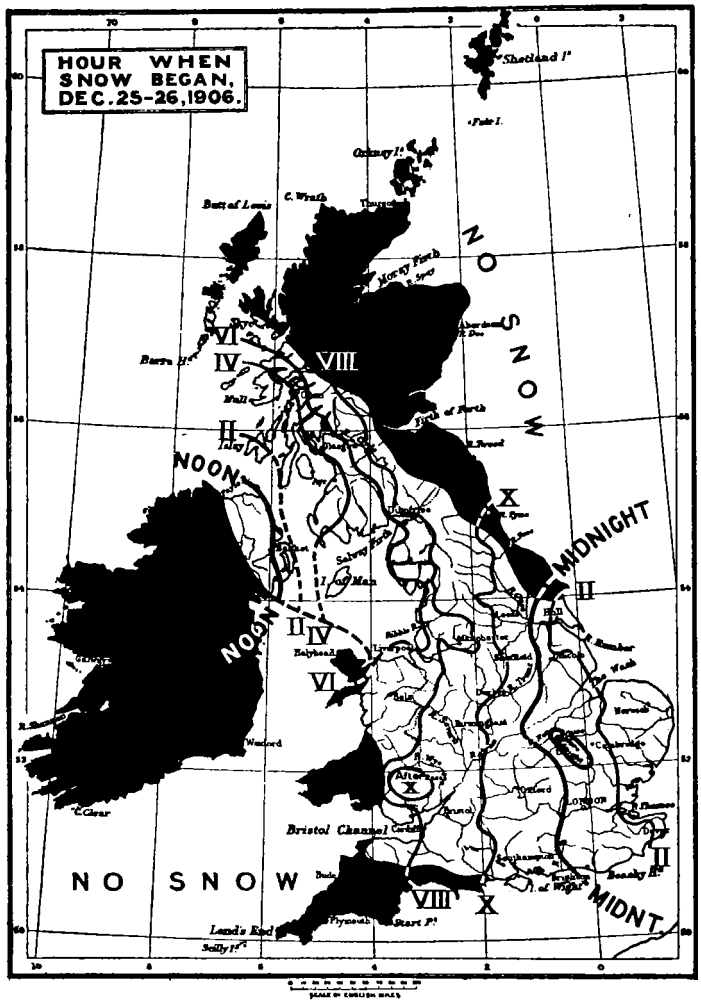

FIG. 2.—Map of isochronic lines, showing time of beginning of snowfall, December 25–26, 1906. Black areas indicate no snow.

Maps of exceptional snowfalls have been made before, and a good example will be found in Symons's Meteorological Magazine for February, 1881 (Vol. 16, frontispiece); but, so far as we are aware, the rate of movement across the country of the beginning of a snowstorm has not been previously mapped with anything like the detail which has been found possible in the present case. The movement of a line-squall across the country has been traced on several occasions from a comparatively small number of observations, the correctness of which was guaranteed in most cases by barograph traces; but here we have had a very large number of observations widely scattered over the whole country. The time of the commencement of the storm was noticed the more carefully because it happened to be on Christmas day or Christmas night, but the exact moment at which the snow commenced could not be given in most cases. A number of observers in those parts of the country where the storm began at night were able to say positively that no snow fell before a certain hour, and a large number had taken the trouble to inquire from policemen, night-watchmen, and others whose duties afford opportunities of noting the commencement of the snow. When all the figures we received had been

charted the hour of commencement was found to be very distinctly later as one proceeded from west to east, and, although the figures were often contradictory, it was possible to draw lines that represent what may be called the prevailing hour of commencement. These lines are drawn in a somewhat generalized form, and it is possible that there should be more anomalous hours of commencement than those which are shown in the two small areas, one in Monmouthshire, the other west of Cambridge; but these were the only places where the weight of evidence seemed to us to demand exceptional treatment. (See fig. 2.)

Speaking generally, the isochronic lines ran from north to south, with a slight tendency to diverge southward; but it may be that they would be better viewed as concentric curves, perhaps portions of circles, the common center of which lay somewhere near the northwest of Ireland. The facts, as shown by the isochronic map, are that the snowstorm began in the north of Ireland shortly before noon of Christmas Day, or about six hours before the center of the depression arrived there, and that the storm began later and later toward the east and south, until it was after 2 a. m. on the 26th before it commenced at the mouth of the Thames, i. e., six hours before the center of the depression arrived there.

It thus appears probable that snow began in the front of the approaching cyclone about six hours in advance of the passing of the trough, and it appears likely that the snowfall lasted until immediately after the trough passed; but the hours given for the cessation of the snow are less precise than those for its commencement. At Camden Square the barograph showed that the trough passed about 6 a. m., after which the barometer began to rise, and the snow ceased about the same time.

The map shows that at noon on Christmas Day snow was beginning on the northeast of Ireland; at 2 p. m. it was snowing along a line from Islay and Kintyre to Larne; at 4 p. m. the snow reached Mull, Galloway, and almost the Isle of Man; at 6 p. m. it almost reached Skye, Glasgow, Dumfries and the coast of Lancashire; at 8 p. m. it was snowing from Skye to Manchester and thence to Cardiff and Bridgwater; at 10 p. m. the line of the commencing storm ran from the Tyne through Leeds, Sheffield, Derby and Birmingham, to near Bournemouth; by midnight it stretched from Goole to Brighton, and, sweeping over London, by 2 a. m. on the 26th, it ran from Hull through Lincoln and Cambridge to Dover. An hour later the storm had passed out into the North Sea, and the whole country was painted white from the Isle of Skye to the Isle of Thanet.

The rate of advance of the front of the storm measured by the commencement of precipitation was least rapid in the north, where it was 12½ miles an hour, and most rapid in the south, where it was about 19 miles an hour, but the rate varied a little from point to point. The interesting fact is, however, that a motor car could have kept out of the storm by traveling, without exceeding the legal speed limit, in the direction of its progress. At 8 o'clock on Christmas night snow was beginning to fall simultaneously along a line of 500 miles, this being the longest snow-yielding portion of the storm front at any time.

WELL-MARKED FOEHN EFFECTS WITH GREAT DIURNAL RANGES OF TEMPERATURE IN SOUTHERN CALIFORNIA.

By Prof. A. G. McADIE. Dated San Francisco, Cal., December 2, 1907.

Some unusual ranges of temperature were recorded in California at the close of November, 1907. A well-marked foehn effect was noticeable in southern California November 29 and 30, and December 1. Maximum temperatures of 86° occurred at Los Angeles and at San Diego on the afternoon of November 29. On the 30th, maximum temperatures of 84° occurred at Los Angeles and at San Luis Obispo, and 80° at San Diego. On December 1 maximum temperatures ranged from 80° to 85° thruout most of California.

The morning temperatures thruout this section were generally low, and at many places frost was reported in the morning. For example, at San Luis Obispo frost occurred on the morning of December 1, with a minimum temperature of 38°, which was also the temperature at the time of the observation—4:45 a. m. The temperature at the time of the regular observation preceding the frost was as high as 86°, and on the afternoon following as high as 84°. We therefore have a range of about 50°; or, allowing 32° for the frost temperature, a cooling of 54° between 3 p. m. and 5 a. m., or about 14 hours. In my experience as forecaster on this coast I do not recall such a temperature amplitude. The frost deposit was probably not heavy; but we must assume that the temperature would have been still lower but for the latent heat of condensation of vapor to water and water to ice.

The illustration is valuable, we think, in connection with the theory of the nocturnal cooling of the ground and atmosphere.[1] The observation may be of value in connection with the determination of the coefficient of radiation of air. It may be assumed that the air was clean, free from dust and water vapor; altho a puzzling condition is that San Luis Obispo is only about 10 miles from the coast. The elevation of the thermometer is about 47 feet above the ground, and the elevation above sea level is about 200 feet. It would seem that under the conditions given, the heat waves—long wave lengths—past thru the air within 40 feet of the ground, with comparatively little absorption. The fall in temperature would seem to be a pure radiation effect and the illustration shows how very important radiation is in frost formation.

THE CENTRAL PENNSYLVANIA METEOR OF OCTOBER 1, 1907.

By Prof. HENRY A. PECK. Dated Syracuse University, Syracuse, N. Y., December 13, 1907.

The evening of October 1, 1907, Mr. Clayton B. Chappell and Mr. T. H. Parkhurst, seniors in the Syracuse University, reported that they had seen a remarkable meteor about 6:30 p. m. A few days afterwards some newspaper clippings arrived, showing that it had been observed over a range of territory that extended from Toronto to New York City. Meanwhile there had appeared in New Jersey and Pennsylvania another meteor of the largest size, which had attracted universal attention over a wide area. The Central Office of the Weather Bureau made a very thoro postal-card canvass of this region, the report of which will appear in a later number of the MONTHLY WEATHER REVIEW. Among the answers were many that evidently referred to the earlier meteor, and it is largely with these as a basis that the following has been written.

Aside from the regular staff of observers of the Weather Bureau, the following have kindly furnished information:

New York.

Charles P. Arnold, Angelica.	O. H. Hauber, Ithaca.
P. J. Flanagan, Brooklyn.	Kenneth Baker, Jamestown.
Felix C. Moore, Buffalo.	W. H. Knapp, Jamestown.
Mrs. Wallace W. Jacques, Chazy.	Charles A. Hoag, Lockport.
C. E. Robinson, Clay.	Mrs. Eugene Buttrick, Lockport.
Mrs. G. O. Barnes, Cortland.	M. D. Clinton, Newark Valley.
Harold Henry, Dannemora.	William P. Ray, Olean.
F. J. Hill, Dryden.	Mrs. A. W. Ferrin, Preble.
Frank Fayent, Fort Plain.	S. C. Williams, Rochester.
Mrs. Nellie Sherman, Greenwood.	C. B. Chappell, Syracuse.
E. L. W. Smithers, Hammond.	T. H. Parkhurst, Syracuse.

New Jersey.

Samuel K. Pearson, jr., Jersey City.

[1] See S. Tetsu Tamura, Monthly Weather Review, April, 1905, vol. xxxiii, p. 138–140.